UNIVERSITI PUTRA MALAYSIA

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By

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In loving memory of

my late beloved father "*Thid Choum*"
who laid my academic career foundation

and

my late beloved mother "*Bouapha*"

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

Abstract of thesis submitted to the Senate of the Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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Chairman : Assoc. Prof. Nor Aini Abd Shukor, Ph. D.

Faculty : Forestry

The supply of sentang (*Azadirachta excelsa*) seeds is limited due to the irregularity of flowering and fruiting and the difficulty of storing seeds for a long period. Therefore, this study examined the possibility of raising planting stock of sentang using cuttings. It involved determination of coppiceability at different stump heights (30, 60 and 100 cm), followed by rooting of these coppices. Also seedlings of two different ages were included in the rooting experiment. Factors such as cutting positions (terminal, middle and basal), as well as different hormonal treatments (control; IBA 50 μg, 100 μg, 150 μg; NAA 100 μg, 150 μg;

Seradix 2; and their combinations between IBA 100 µg and NAA 50 µg) were included in this experiment.

Results indicated that 60 cm stumps gave the best survival percentage (96.9%) with the best coppiceability in terms of sprout number production (9). However, the best coppiceability in terms of shoot length (39.6 cm) and diameter (0.7 cm) was recorded in the 100 cm stumps. Generally, terminal position was found to be the best cutting position for both plant sources (coppices and seedlings) for survival and rooting percentages. Hormonal application gave a significant effect at $P \leq 0.05$ on rootability of cuttings. The highest rooting ability (73.3%) was obtained from terminal cuttings of 23 month-old from FRIM seedlings when treated with 100 µg IBA. In contrast, survival percentages of only 20% and 50% were obtained from terminal cuttings of 34 month-old seedlings and 4 month-old coppices treated with Seradix 2 respectively. In addition, the 3 week-old coppice cuttings were also tried to further determine whether rootability could be improved and results indicated that single-node coppice cuttings from 30 cm stumps gave an 80% survival, followed by the 60 and 100 cm stumps which recorded similar survival percentages of 47%.

Generally, the rooting ability recorded was relatively low i.e. 36%, 18% and 11% from 30, 60 and 100 cm stumps respectively.

Hormonal application showed significant effects at $P \leq 0.05$ on rooting ability. Seradix 2 was the most effective hormone used. A similar trend was also shown in the root development in terms of root number, length and dry weight for both seedling and coppice cuttings. Nevertheless, terminal cuttings of seedlings treated with 100 μg IBA or coppice cuttings treated with seradix 2 and IBA 50 μg, gave the most promising root development.

Based on the results obtained, it can be concluded that sentang could be vegetatively propagated by rooting of cuttings, and it has potential in being used in clonal forestry.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
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PEMBIAKAN TAMPANG MENGGUNAKAN KERATAN BERAKAR POKOK SENTANG *AZADIRACHTA EXCELSA* (JACK) JACOBS

Oleh

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Kekurangan bekalan biji benih sentang (*Azadirachta excelsa*) adalah disebabkan ketidaktentuan musim berbunga dan berbuah, dan tempoh ketahanan/ penyimpanan biji benih yang singkat. Oleh itu, kajian ini adalah untuk mencari suatu protokol dan teknik yang sesuai bagi menghasilkan stok tanaman yang mencukupi dengan menggunakan keratan. Ia melibatkan penentuan kebolehan berkopis pada ketinggian tunggul yang berbeza (30, 60, dan 100 cm), dan kebolehan pengakaran kopis tersebut. Rawatan lain melibatkan penentuan kebolehan berkopis pada umur yang berbeza, kedudukan keratan berlainan (hujung, tengah, dan pangkal), serta menggunakan hormon dan kepekatan horman

yang berbeza (kawalan; IBA 50 µg, 100 µg, 150 µg; NAA 100 µg, 150 µg; Seradix 2; dan kombinasi IBA 100 µg dan NAA 50 µg).

Kemandirian tertinggi (96.9%) dan tahap berkopis terbaik dari segi bilangan pucuk (9) diperolehi pada ketinggian tunggul pada 60 cm. Tetapi, tunggul pada ketinggian 100 cm mencatitkan tahap pengkopisan terbaik dari segi panjang pucuk (39.6 cm) dan diameter (0.7 cm) yang mana disebabkan oleh faktor kurangnya persaingan oleh kerana terdapat banyak tunas epikomik. Keratan terminal dan anak pokok dari umur yang berbeza menghasilkan purata kemandirian pengakaran 37.7%. Rawatan hormon menunjukkan perbezaan yang bererti pada $P \leq 0.05$ di atas pengakaran keratan terutamanya apabila dirawat dengan 100 µg IBA, iaitu keratan hujung anak pokok dari FRIM (73.7%). Anak pokok berusia 26 bulan dari Kelantan dan 4 bulan dari keratan hujung kopis yang dirawat dengan Seradix masing-masing menunjukkan peratus pengakaran 20% dan 50%. Kopis yang diambil dari ketinggian tunggul 60 cm memberikan purata pengakaran 16.2% diikuti dengan ketinggian tunggul 30 cm (11%) dan 100 cm (9.1%). Juga, kopis berusia 3 bulan telah dicuba untuk menentukan samada kebolehan pengakaran boleh dipertingkatkan.

Keputusan menunjukkan kopis dari satu tunas dari ketinggian tunggul 30 cm memberikan 80% kemandirian, sebaliknya cuma 47% dicatitkan oleh kedua-dua tunggul yang lain. Secara keseluruhannya kebolehan pengakaran adalah rendah; 36% (30 cm), 18% (60 cm), dan 11% (100 cm).

Penggunaan hormon menunjukkan kesan yang bererti ($P \leq 0.05$) ke atas kebolehan pengakaran keratan. Rawatan Seradix 2 memberikan kesan terbaik. Keputusan yang sama ditunjukkan oleh pengembangan akar dari segi bilangan akar, panjang dan berat kering untuk anak pokok dan kopis. Secara menyeluruh, keratan hujung anak pokok yang dirawat dengan 100 µg IBA atau keratan kopis yang dirawat dengan Seradix 2 dan IBA 50 µg menghasilkan pengembangan akar yang paling menggalakkan.

Daripada keputusan yang diperolehi, bolehlah disimpulkan bahawa bekalan anak pokok sentang boleh dihasilkan melalui keratan bagi bekalan tanaman di ladang.

CHAPTER I

INTRODUCTION

General Background of Tropical Forest

Tropical forests cover about 14 % of the Earth's land surface (8 million square kilometer) and are exceptionally rich in biodiversity of flora and fauna. They contain half of all vertebrates, 60% of known plant species, and possibly 90% of the world's total species (Thang, 1993).

Throughout the tropical world, forest lands have been cleared extensively for other land uses such as shifting cultivation, agricultural development (crops plantation), infrastructure (housing, roads, railways, power-stations, water supply, etc.), and logging for timber. An average of 15.4 million ha of tropical forest has disappeared each year from 1981 to 1990 (FAO, 1993). If the deforestation still continues at this rate, the remaining tropical forests would disappear within 60-80 years.

Malaysia, located north of the Equator within latitudes of 1° to 7° North and longitudes of 100° to 119° East is one of the countries having tropical rainforests (Figure 1). The total land area of Malaysia is 32.97 million hectares. As at the end of 1996, 18.91 million ha (58.29% of the total land area) were forested. Of these, 6.02 million ha are in Peninsular Malaysia, 4.50 million ha in Sabah and 8.70 million ha in Sarawak (Ministry of Primary Insdustries Malaysia (MPIM), 1996). A total of 14.28 million ha has been earmarked as Permanent Forest Estate.

The Permanent Forest Estate is further divided into protection (3.66 million ha) and production (10.53 million ha) forests (MPIM, 1996). Only the production forest (10.53 million ha) will be managed for sustained timber harvesting while the protection forest is preserved in its natural state to protect the climate, physical condition of the country, water supply and biodiversity as well as genetic diversity. Unfortunately, the deforestation rate in Malaysia has also been quite high. Over 2 million hectares of its forest were cleared in the last two decades for conversion to other land uses such as rubber and oil palm plantations, housing, industrial land, and infrastructural development (Lim and Faridah, 1992). This rapid destruction of forest globally gives rise to much apprehension. Thus the loss of the forest resources has greatly affected the Malaysian economy, its environmental stability and the sustainability of the sources.

Realizing the above implications, the forestry sector has taken several steps involving the silvicultural management of the natural regeneration after logging, and

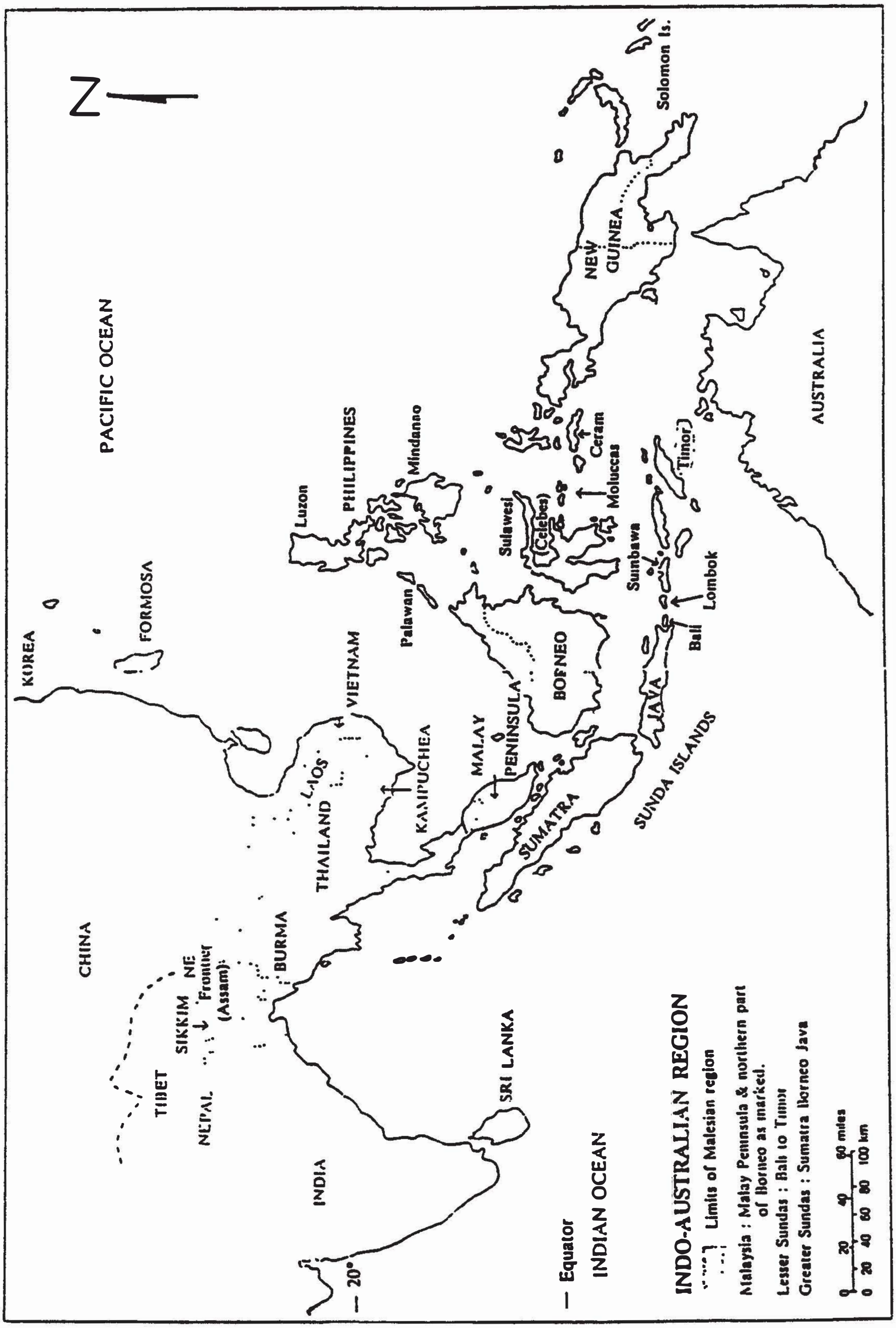

Figure 1: Distribution of *A. excelsa* in the South-east Asia i.e from Peninsular Malaysia to as far as Mergui in Myanmar, Philippines, Borneo, New Guinea (Schmutterer and Doll, 1993)

the establishment of forest plantations with selected desirable species in terms of fast growth and multipurpose uses for future consumption.

Azadirachta excelsa (Jack) Jackobs, is one of the potential species considered for commercial plantations (Malaysian Timber, 1997). A report by the International Tropical Timber Organisation (ITTO) (1997) has also considered *A. excelsa* (Sentang) as one of the four important commercial plantation species besides teak, acacia and rubber. This study focused on *A. excelsa* from the family Meliaceae which is considered as one of the lesser known tree species of the non-dipterocarp group.

Description of *A. excelsa* (Meliaceae)

A. excelsa (Jack) Jacobs, belongs to the family Meliaceae. It was formerly known as *Melia excelsa* or *Azadirachta integrifolia* (Burgress, 1966). The family Meliaceae contains a large number of species, many of which have been very imperfectly studied, and many of which do not grow to timber size (Burgress, 1966). Meliaceae is predominantly found in the lowland forest and very few could be obtained in the mountains. However, family Meliaceae also includes species of major economic importance in the forestry of many countries. It produces high quality timber like Mahagony (*Swietenia* spp.), which is one of the most decorative woods of commerce. It also produces some other commercial value species such as

Australian Yellow Wood (*Flindersia)*, the Satin Wood (*Chroroxyln*), the Chittagong Wood (*Chickrassia*); the Toon Tree (*Cedrela*) of India and the Cedar (*Khaya*) of Africa. The family Meliceae has 50 genera with 500 to 1000 species and are mostly tropical. In Malaysia itself, there are 16 genera with 50 to 100 species (Corner, 1988).

A. excelsa is a lesser known mono specific timber species (Wong, 1976). It inhabits a vast region in South-east Asia from Malaysia, Thailand, Myanmar to the Philippines, Borneo, Basilan and Masbate, New Guinea and Aru Islands (Burgress, 1966; Corner, 1988; Schmutterer and Doll, 1993 (Figure 1)). The vernacular name varies with countries for example: Setang, Seta, Sentang and Jati Tiruan (Peninsular Malaysia); Limpaga, Ranggan (Sabah); Ranggu (Sarawak); Tiem (Thailand); Mimba, Surian Bawang (Indonesia); and Maranggo, Kalantas (Philippines).

A. excelsa thrives in moist tropical rainforests where precipitation is usually about and above 1600 mm/annum. It can also grows well in tropical dry evergreen forest where rainfall is about 1200-1500 mm/annum. In fact this tree is considered as a hardy species and has a good survival even when the weather condition is not favourable (Barnard,1954). Generally, *A. excelsa* is found in the lowlands, but it could also be found in areas above 250 m above sea level such as in Pangi, Sabah and may extend even higher than this in western Sabah (Burgress, 1966). *A .excelsa* is usually a strong light demander, fast growing and dominates other moist evergreen forest species. Its timber can be harvested after six years when its diameter can reach up to 50-80 cm (Anon, 1995). It may attain a height of 45 m and